

Published data about the prevalence of tapeworm infestations is most of the time based on coproscopical studies and therefore usually low due to the lack of sensitivity of the technique, ranging from 0.5 to less than 15% (table).

TAPEWORMS SPECIES	PREVALENCE BASED ON FAECAL TECHNIQUES	REFERENCE
<i>Dipylidium caninum</i>	0%	Little <i>et al.</i> , 2015
	0.5%	Diakou <i>et al.</i> , 2017
	0 - 33%	Rabbani <i>et al.</i> , 2020
	1.1%	Nagamori <i>et al.</i> , 2020
<i>Taenia taeniaeformis</i>	8.3%	De Souza <i>et al.</i> , 2017
	0.5%	Diakou <i>et al.</i> , 2017
	1.2%	Nagamori <i>et al.</i> , 2020
	4.8 - 12.7%	Little <i>et al.</i> , 2015
<i>Joyeuxiella spp./ Diplopylidium spp.</i>	9%	Loftin <i>et al.</i> , 2019
	7%	Diakou <i>et al.</i> , 2017
<i>Dibothriocephalus spp.</i>	1.67 - 5%	Rabbani <i>et al.</i> , 2020
<i>Spirometra spp.</i>	9%	Loftin <i>et al.</i> , 2019

Tapeworms are usually well tolerated, causing moderate intestinal disorders, such as anal pruritus, colic, diarrhoea, vomiting, decreased weight and variable appetite. **Nevertheless, in the absence of any treatment, the parasite burden will impair the cat's health.**

Lungworms, intestinal protozoans and tapeworms are widespread parasites that impair the cats' health, most of the time rather silently. Due to remaining carriage of intestinal protozoans in apparently healthy cats, compliance with the basic sanitary measures in feline breeding units is essential for the prevention of Giardiasis and Trichomonosis. Despite or because of the hurdles encountered in identifying lungworm and tapeworm presence or responsibility in diseases, these parasitic infestations must not be overlooked and should be considered in the regular deworming plans for cats, based on the risk or exposure assessments.

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There are exceptions to this general rule of low pathogenicity:

- Mesocestoides* spp.: In some cases, carnivores (including cats) can act as intermediate hosts for this cestode, with a multiplication of larvae in the abdominal cavity, which may evolve into a peritonitis.
- Dibotriocephalus latus* is the most pathogenic tapeworm in cats as in humans, causing intestinal disorders, abdominal discomfort, diarrhoea and anaemia.

TAPEWORMS ARE MISSED, OR OVERLOOKED DUE TO THE FOLLOWING:

- Infestations are generally asymptomatic**, even in *Mesocestoides* infestations where diagnosis is often made accidentally during surgery when lots of larvae looking like semolina grains are visible.
- Visual observation of proglottids in cats harbouring cestodes is not a reliable detection technique**^[19]. Cats rarely excrete gravid segments directly in their faeces, as proglottids usually move out of the anus and around the perianal region by themselves and fall off in the environment.
- Routine veterinary tests (i.e., coproscopy using flotation or sedimentation techniques) are unlikely to identify tapeworm presence.** The absence of agreement between faecal and necropsy findings was demonstrated in several studies, with 9%^[15] or 4.8-12.7%^[19] of cats diagnosed for *Taenia taeniaeformis* and 0%^[15,19] for *Dipylidium caninum* through faecal techniques, while necropsy showed that 25.9%^[19] -36%^[15] and 29%^[15] -34.9%^[19] of cats were indeed infested with these tapeworm species respectively.



Serviceplan | Crédits photos : iStock, Boehringer Ingelheim.

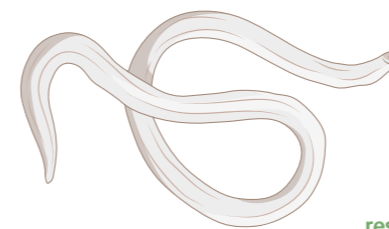


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TOP 3 OFTEN MISSED PARASITES IN CATS

Due to their specific behaviors and lifestyle, cats are particularly exposed to multiple parasitic infestations. Nevertheless, even the vet practitioner may miss the presence of parasites, particularly when it comes to internal parasites. Indeed, diagnosis is often challenging from a clinical point of view, and these parasites may be overlooked, misdiagnosed, or simply not detected by routine veterinary tests. This is especially the case for lungworms, intestinal protozoan parasites and tapeworms.

LUNGWORMS



Aelurostrongylus abstrusus and *Troglostrongylus brevior* are both metastrongyloid nematodes from the Angiostrongylidae and Crenosomatidae family, respectively. Adult *A. abstrusus* reside in the terminal bronchioles, alveolar ducts, and alveoli of felids, while adult *T. brevior* live in the upper respiratory airways (bronchi, large bronchi, and trachea).

These lungworm species occur in cats wherever the intermediate hosts (several species of molluscs: slugs and/or snails) are found. Epidemiological studies and case reports have confirmed the presence of *A. abstrusus* in the Americas, Europe, Asia and Australia^[1]. Wild mice and other rodents, along with frogs, toads, snakes, lizards, and small birds, can serve as paratenic hosts (transport hosts). Cats preying on small animals have therefore a higher risk of infestation.





Capillaria aerophila egg.

Capillaria aerophila (syn. *Eucoleus aerophilus*) is a trichuroid nematode. Adult stages **live on the epithelium of bronchi and trachea** of different vertebrate hosts, including cats. This worm has a direct biological cycle, **contamination occurring through the ingestion of infective eggs from soiled environment**, even if

earthworms are hypothesized to be involved as facultative intermediate or paratenic hosts.

Whatever the species involved, **lungworms can elicit various clinical manifestations, ranging from subclinical or minimal respiratory signs to interstitial bronchopneumonia**, with cough and sneezing, difficult, labored breathing (dyspnoea), and respiratory distress in heavy infestations. Clinical signs may lead to the death of the cat, especially in young and/or immunocompromised individuals^[2,3].

1 out of 10 domestic owned cats are commonly found positive for lungworm infestation^[4,5], this percentage being higher in cats known to exhibit a preying behavior^[5] and in free roaming individuals^[6].

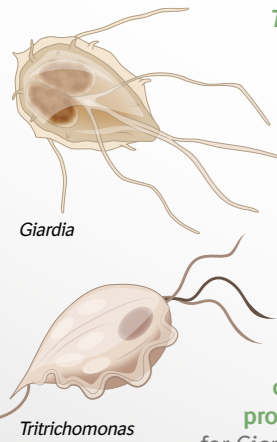
- *A. abstrusus* is the most frequently diagnosed species, followed by *T. brevior* and/or *C. aerophila*. **It is considered the main feline lungworm** throughout the world
- *T. brevior* infestation seems to be more commonly found in animals aged up to 6-month-old than in older cats.

SEVERAL REASONS MAY EXPLAIN WHY LUNGWORMS ARE OFTEN MISSED IN CATS:

- **Cats often present with unspecific or absent clinical signs**^[2,3,5,6,7]. As an example, in the 2017 study^[5], only ~45% of infested kittens displayed respiratory signs (e.g., sneezing, coughing, dyspnoea).
- **Viruses** (Calicivirus, Herpes virus), **bacteria** (*Chlamydophila felis*, *Bordetella bronchiseptica*) and **allergenic agents** (leading to allergic bronchitis and asthma) are the most **usual suspects in feline respiratory diseases, and verminous bronchitis/pneumonia are overlooked in cats' differential diagnosis**.
- **The most effective way of diagnosing *A. abstrusus* or *T. brevior* infestation is through the Baermann technique**, allowing to collect larvae from the faeces, but:
 - The method is not as easy as classical coproscopy and rarely used by vet practitioners,
 - Parasites may be missed due to prepatent period and intermittent larval shedding.
- **Capillaria eggs found in copromicroscopy may be mistaken with *Trichuris vulpis* eggs** due to their similar shape.^[7]

“Any respiratory sign in an at-risk cat should ring an alarm bell for clinicians working in lungworm-endemic areas or with travelling pets.”^[8]

INTESTINAL PROTOZOANS



Tritrichomonas blagburni (formerly *T. foetus*) and *Giardia duodenalis* are flagellate protozoan parasites, **responsible for chronic diarrhoea (enteritis and colitis respectively) in cats**. *Giardia* infect the epithelium of the small intestine, while *Tritrichomonas* are found in the superficial mucus and in contact with the epithelium surface of the large intestine.

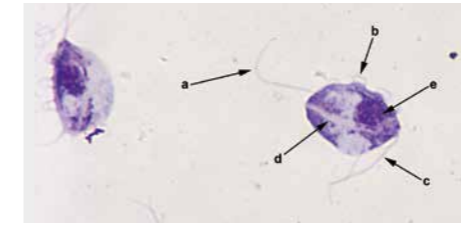
In both cases, contamination occurs orally by ingestion of the protozoan infective stages (i.e., cysts for *Giardia*, trophozoites for *Tritrichomonas*) **from faecal-contaminated matters** (water, food, fomites), or through self-grooming. Litter boxes play a key role in the parasite transmission between cats of the same household or cattery: any time cats may step in infected faeces, parasites can be transferred to the paws that will be later be licked during grooming. It is noteworthy that due to the absence of cysts, *Tritrichomonas* trophozoites may only survive around 3 days in moist faeces, while *Giardia* cysts can resist for several weeks in a moist environment. **Cats from communities (catteries or shelters) therefore appear at higher risk**, even if infection is also observed in isolated individuals. As well, these infections are **more frequent in young animals (under one or two years of age)**.



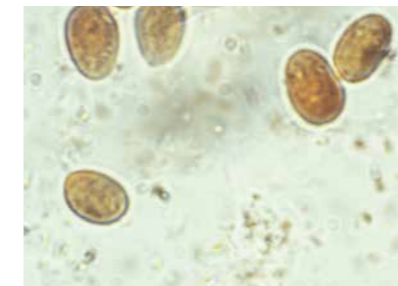
Trichomonosis is characterized by a painful and malodorous large bowel diarrhea with a ‘cow pat’ consistency that may last only one day or become chronic with episodes re-occurring for several years.

Giardiasis chronic forms are expressed through pasty, foul-smelling diarrhoea and steatorrhea.

The prevalence of these protozoan infections varies between published studies, from 10 to 60%.^[9,10]



Cytological preparation of cultured feline *Tritrichomonas blagburni*.



Giardia cysts are more or less rounded with a thin and smooth shell. Lugol's iodine stain make them take on a very clear orange hue.

Regarding both protozoan species:

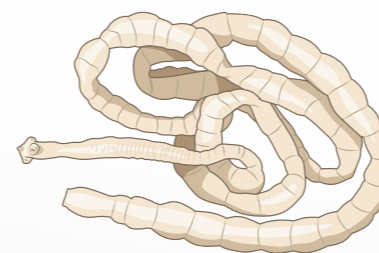
- **A negative result does not mean that the cat is not infected.** Tests should be repeated, or different techniques should be associated.
- Some cats remain **carriers** of the parasites and **will be sources of contamination for their congeners**.
- **Many recurrences usually occur**, probably due to recontamination.

TAPEWORMS

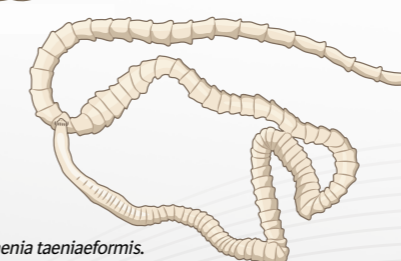
Cats can be infested by several tapeworm species belonging to the cestode class, **the most common ones worldwide being *Dipylidium caninum* and *Taenia taeniaeformis***^[11,12].

On top of these well-known species, infestations with *Joyeuxiella* spp., *Diplopylidium* spp., *Mesocestoides* spp., or with the ‘broad tapeworms’ *Dibothriocephalus* spp. (formerly *Diphyllobothrium* spp.) and *Spirometra* spp. can also be observed^[6, 14-16].

In the end, although cats are less suitable hosts than canids, infestations by *Echinococcus multilocularis* have been reported.^[17,18]



Dipylidium caninum.



Taenia taeniaeformis.

PROTOZOANS ARE OFTEN MISSED IN CATS BECAUSE:

- **Cats chronically infected by *Giardia* usually stay in good health** with only transient or intermittent episodes of diarrhoea: **the protozoal infection is then overlooked. *Tritrichomonas* infection tends to be more pathogenic.**
 - **In *Giardia* spp. infections**, chronic and healthy carriers shed cysts intermittently and **the faecal examination may be falsely negative**.
 - ***T. blagburni* cannot be detected by routine fecal analyses** such as centrifugation flotation. The protozoans may be observed only in a smear of fresh faecal samples, and the organisms do not survive refrigeration. *Tritrichomonas* can also be recovered from the culture of fresh faeces in a specific medium. Despite multiple means for diagnosis of the infection, including light microscopy, protozoal culture and PCR amplification using species-specific primers, tests with even greater sensitivity are needed.
- Misdiagnosis of *Giardia* species infection is common in cats with trichomonosis:** cats diagnosed with *Giardia* based on a direct faecal smear examination and that fail to respond to an appropriate antimicrobial therapy should be re-evaluated for trichomonosis, but only after several days because antimicrobials may mask the infection.

Overall, infestation occurs in cats ingesting the intermediate host/second intermediate host or the paratenic host of the tapeworm. Depending on the cestode species, cats will get infested through grooming (the cat flea being the main intermediate host for *D. caninum*), or preying on rodents, reptiles, amphibians, birds, or by eating fishes from freshwater/lakes. **As for lungworms, cats exhibiting a preying behavior are therefore at a higher risk of tapeworm infestation**, as shown in studies including free roaming cats^[6,16]. In this population, the infestation rate can be incredibly high, reaching more than 80% of cats^[6] (83.3% for *Dipylidium caninum* in this study).

